

PATENT  
9031-1017

IN THE U.S. PATENT AND TRADEMARK OFFICE

In re application of

Warren SMOOK et al.

Conf. 1343

Application No. 10/563,461

Group 3655

Filed January 5, 2006

Examiner Tisha D. LEWIS

GEAR TRANSMISSION UNIT WITH PLANET CARRIER

DECLARATION UNDER RULE 132

Commissioner for Patents  
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Alexandria, Virginia 22313-1450

Sir:

I, Warren SMOOK, a named inventor, am a citizen of Belgium and reside at B-3040 Huldenberg, Breembosstraat 16, Begium.

I am familiar with the above-identified U.S. patent application including the Examiner's position that it would have been obvious to substitute the spherical roller bearings (SRBs) of any one of WO 02/079644, WO 02/14690, or WO 03/014566 with the taper roller bearings (TRBs) of WO 03/002891 to produce a planet bogie plate that provides support for circumferentially spaced shafts, which at least some of which are taper roller bearings, because it is known in the art to use taper bearings to support planet gears mounted on a plate.

The Teachings of WO '644:

WO '644 discloses the use of a bogie plate with spherical roller bearings. Such bogie plate is designed to allow self-adjustment of the planets so as to achieve the optimum load distribution in the planetary cell. However, this reference does not teach taper roller bearings.

The Teachings of WO '690:

WO '690 discloses a drive assembly for a wind turbine comprising a planet carrier which is provided with three integral and circumferentially spaced studs which support a planet bogie plate. However, this reference does not teach the use of taper roller bearings for supporting the planet gears.

The Teachings of WO '566:

WO '566 discloses a drive assembly for a wind turbine comprising a planet carrier comprising a planet bogie plate which supports and locates circumferentially spaced planet gear bearings which are able to self adjust in angular position relative to the bogie plate. However, this reference does not teach the use of taper roller bearings for supporting the planet gears.

The Teachings of WO '891:

This reference teaches the use of taper roller bearings for supporting planet gears on a planet carrier comprising a carrier flange to which all the planet gears are coupled. In addition to the carrier flange, the carrier has carrier pins which project from the flange into the planet gears.

Comparison with the Present Invention

The present invention provides a planetary gear transmission unit comprising a planet carrier having circumferentially spaced studs which support a planet bogie plate. The planet bogie plate provides support for circumferentially spaced shafts which support and locate circumferentially spaced planet gear bearings on which planet gears are mounted. According to the present invention at least some of the planet gear bearings are taper roller bearings.

Essence of the invention

The concept of the planetary gear transmission unit according to the present invention takes advantage of the advantages of TRBs over SRBs without significantly altering the load sharing advantages inherent to the bogie plate with SRB design, as the use of the combination of TRBs for supporting the planet gears with a bogie plate still allows

for a good load distribution, although having less degrees of freedom compared to SRBs.

#### Why TRBs Were Chosen

Advantageous properties of TRBs may be:

- TRBs can be pretensioned which leads to a smaller clearance in the unloaded zone during operation. Such smaller clearances allow to better control the rollers of the bearings in the unloaded zone.
- TRBs have a pure kinematical rolling action without slip. This is not the case for SRBs which always have locations in the roller-raceway contact where slip occurs which could lead to additional stresses.

#### Conclusion

One of ordinary skill in the art did not consider TRBs in combination with a bogie plate because one loses degrees of freedom with regard to a SRB. A planet supported by a TRB has one degree of freedom (DOF), i.e. rotation around it's own axis, while a planet supported by a SRB can rotate around the main axis of rotation as well as two other axis that are perpendicular to the main axis. Thus, the combination bogie plate/TRBs has a lower number of DOF than the combination bogie plate/SRBs.

In view of this, one of ordinary skill in the art would not have substituted TRBs for the SRBs of WO '644 (see

page 2, lines 14-21 of WO '644 wherein SRBs are required to ensure uniform load distribution).

Furthermore, it was discovered, counter to expectations, that not having the added degrees of freedom of the planets on SRBs did not impact significantly on the load distribution between the planets on each shaft nor on the face load distribution of each individual planet.

Hence, the present inventors discovered that, although having less degrees of freedom compared to the case where SRBs are used, the combination of a bogie plate with TRBs still allows a good load distribution.

In other words, the 1 rotational DOF left in the planet/bearing assembly combination with self-adjusting characteristics of the planet shaft in the bogie plate is sufficient to result in a good load distribution.

Thus, although one of ordinary skill in the art knows that there are differences in degree of freedom between spherical roller bearings and tapered roller bearings, nevertheless, and because of this difference, one of ordinary skill in the art would not have substituted TRBs for the SRBs, in the belief that such a change would significantly (and negatively) impact the load distribution in the planetary cell

That is, at the time of filing, it was commonly believed that a sufficiently high degree of freedom was necessary in order to have a proper functioning of the gear

unit and for that reason spherical roller bearings were always used. Starting from the function of the bogie plate by which the degrees of freedom in the contact with the planet shaft and the degrees of freedom of the SRB planet bearings are used for (1) proper load distribution between the planets on a shaft and (2) for proper face load distribution for each individual planet, it was expected that a bogie plate with TRB planet bearings would be able to fulfill the first function (1) but would perform less well in the latter (2).

Hence, the recited bogie plate combined with TRB planet bearings was never proposed before because it was believed that such a design would potentially suffer from face load distribution problems at the time of filing based on a lack of degree of freedom.

In view of this, it would not have been obvious to one of ordinary skill in the art to combine the references in the manner suggested.

I further declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under §1001 of Title 18 of the United States code and that such willful false statements

may jeopardize the validity of the application or any patent  
issuing thereon.

Date 29/10/2009

  
Warren Smook